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Indian Standard

GENERAL REQUIREMENTS AND CLASSIFICATION OF TESTS FOR SEMICONDUCTOR DEVICES

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GENERAL REQUIREMENTS AND CLASSIFICATION OF TESTS FOR SEMICONDUCTOR DEVICES

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Indian Standard

GENERAL REQUIREMENTS AND CLASSIFICATION OF TESTS FOR SEMICONDUCTOR DEVICES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 April 1981, after the draft finalized by the Semiconductor Devices and Integrated Circuits Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard deals with general requirements, such as material, construction and workmanship, marking, procedure for approval of devices (type approval and batch acceptance approval) including classification of tests, etc, as applied to semiconductor devices. This standard is a necessary adjunct to relevant Indian Standard for a given device which may include, among other things, details of ratings, characteristic values, dimensions and other applicable requirements.

0.3 While preparing this standard, assistance has been derived from the following documents:

BS 9300 : 1968 Specification for semiconductor devices of assessed quality: Generic data and methods of test. British Standards Institution.

JSS 51300 (Part I)-1971 General requirements for semiconductor devices. Directorate of Standardization, Department of Defence Production, Ministry of Defence, New Delhi.

1. SCOPE

1.1 This standard relates to the general requirements, classification of tests and other related aspects as applicable to semiconductor devices.

2. TERMINOLOGY, GRAPHICAL SYMBOLS AND LETTER SYMBOLS

2.1 For the purpose of this standard, the following terms and definitions shall apply in addition to terms and definitions given in IS : 1885 (Part VII)* series.

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*Electrotechnical vocabulary: Part VII Semiconductor devices.

2.1.1 *Ambient Rating Method* — A method in which the ratings are quoted in terms of the ambient cooling conditions.

NOTE — The ambient cooling conditions may be either natural air cooled conditions or circulation cooled conditions.

2.1.2 *Ambient Rated Devices* — Semiconductor devices for which the ratings are quoted in terms of ambient cooling conditions.

2.1.3 *Cooling Conditions* — The conditions of the surroundings determining the manner in which the heat is removed from the device.

2.1.4 *Reference Point Temperature* — The temperature measured by a specified method at a specified point on or near the device.

NOTE — The exact position of the reference point temperature should be well defined.

2.1.5 *Case Rating Method* — A method in which the ratings are quoted in terms of the temperature of a reference point on the device.

2.1.6 *Case Rated Devices* — Semiconductor devices for which the ratings are quoted in terms of the temperature of a reference point on the device.

2.1.7 *Structurally Similar Devices* — Devices manufactured on the same production line, by the same production technique and to the same device design, with the same material requirements but differing only electrically.

Examples:

1) Rectifier diodes and thyristors grouped into different voltage ratings.
2) Transistors grouped for gain limits, voltage ratings or frequency characteristics.

2.2 For letter symbols, reference may be made to IS : 3715-1971*.

2.3 For graphical symbols, reference may be made to IS : 2032 (Part VIII)-1965†.

3. INFORMATION TO BE SUPPLIED BY THE PURCHASER

3.1 This shall be in accordance with the relevant detail specification.

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*Letter symbols for semiconductor devices.

†Graphical symbols used in electrotechnology: Part VIII Semiconductor devices.

4. MATERIAL, CONSTRUCTION AND WORKMANSHIP

4.1 Material — The devices shall be constructed from materials free from flaws and other defects. The materials used for construction shall not be susceptible to any mutual chemical reaction; shall be non-flammable, non-explosive and non-corrosive.

4.2 Construction — The methods of attachment of the terminations shall be proper and such that all the electrical connections are mechanically secure and electrically continuous.

All nuts, screws, washers, including lockwashers used in the construction of the semiconductor devices shall be of standard sizes and threads (*see* IS : 4218* series).

4.3 Workmanship — All the components shall be manufactured and processed in a thoroughly workman like manner and in accordance with good design and sound engineering practice.

4.4 Finish — Unless otherwise specified all exposed materials liable to the deterioration in moist or corrosive atmosphere shall be given suitable finish.

5. GENERAL REQUIREMENTS

5.1 Specifying Ratings and Characteristics — The provision of **4** of IS : 3700 (Part I)-1972† shall apply.

5.2 Cooling Conditions — The provision of **5** of IS : 3700 (Part I)-1972† shall apply.

6. MARKING

6.1 The following information shall be marked on each semiconductor device in the following order of preference indicated as the space permits:

a) Terminal identification;

b) Code designation as per IS : 4411-1967‡;

c) Manufacturer's reference or assigned type number (*see* Note 1);

d) Manufacturer's name or trade-mark;

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*ISO metric screw threads.

†Essential ratings and characteristics of semiconductor devices: Part I General (*first revision*).

‡Code of designation of semiconductor devices.

e) Date code (*see* Note 2); and

f) Any other marking either as specified in the detailed specification or as agreed between the manufacturer and the purchaser (*see* Note 3).

Note 1 — A suitable colour band identification may be adopted as given in **6.3** for marking manufacturer's type number.

Note 2 — For date code reference should be made to **6** of IS : 8186-1976*.

Note 3 — Additional marking if any, shall be so applied as not to cause confusion with the marking specified in **6.1** and as to be well separated from them.

6.1.1 All the marking except the terminal identification shall also appear on the container (for example, carton box, plastic envelop, etc, used as an initial protection or wrapping of the devices) in addition to the following:

a) The total number of components packed in each container, and

b) Country of manufacture.

6.2 Terminal Identification — The terminals of semiconductor devices shall be identified in one of the following ways:

a) In accordance with the specified outline drawing (*see* IS : 5000† series).

b) In accordance with one of the methods as appropriate, specified in **6.2.1** to **6.2.3**.

c) As specified in the relevant detail specification.

6.2.1 *Diodes and Rectifiers* — The terminals of all diodes and rectifiers shall be clearly indicated by one or more of the following:

a) A diode graphical symbol with the arrow pointing towards the cathode terminal for forward bias.

b) For plastic encapsulated wire ended diodes and rectifiers the cathode terminal may be indicated by a modification of contour within the maximum body dimensions at the cathode end, that is, conical, stepped or as otherwise considered to be appropriate.

6.2.2 *Thyristor* — The terminals of the thyristor shall be clearly indicated by any one or more of the following:

a) A graphical symbol for a thyristor with the arrow pointing towards the cathode terminal.

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*Marking codes for values and tolerances of resistors and capacitors.

†Dimensions of semiconductor devices.

b) When any thyristor terminal is identified by colour coding, following colours shall be used:

   1) Cathode terminal(s) — Red
   2) Anode terminal — Blue
   3) Gate terminal — Yellow

6.2.3 *Transistors* — The transistor terminal shall be identified as given in the relevant detail specification.

NOTE — In case of transistors/thyristors, emitters/cathode on the fourth terminal identification shall be indicated in the relevant detail specification.

6.3 The semiconductor devices may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. TYPE APPROVAL PROCEDURE

7.0 Type Approval Procedure — Unless otherwise specified the procedure for type approval shall be in accordance with IS : 2612-1965*.

7.1 Provision of Samples — Unless otherwise specified, the manufacturer shall submit 60 specimens of each type for which the approval is desired. In case several electrically and structurally similar devices are submitted for approval at a time, the sample size shall be indicated in the relevant detail specification.

7.2 Grouping of Specimens — The specimens shall be grouped as indicated in Table 1.

7.3 Test Incidence — Group O tests shall be carried out prior to the commencement of tests on subsequent groups and the results shall be recorded. Each test shall be applied in the order listed and where measurements are required the results shall be recorded. Where tests are not applicable this shall be indicated in the relevant detail specification.

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*Recommendation for type approval and sampling procedures for electronic components.

TABLE 1 TYPE APPROVAL TESTS

(*Clause* 7.2)

GROUP	NO. OF SPECIMENS	TITLE OF TEST
(1)	(2)	(3)
0	All	Visual examination
1	10	Electrical parameters Physical dimensions Solderability Resistance to soldering heat Temperature cycling Robustness of terminations Sealing Moisture resistance
2	10	Impact or shock Vibration, variable frequency Constant acceleration
3	10	Low air pressure Salt mist
4	10	Robustness of terminations and integral mounting devices
5	10	Life (high temperature, non-operating)
6	10	Life (steady state operation) and/or intermittent life

8. BATCH ACCEPTANCE PROCEDURE

8.1 Lot or Batch — Unless otherwise specified in the relevant detail specification, a lot or batch shall be as specified in IS : 2612-1965*, and shall consist of devices of a single type or may consist of a collection of subbatches of structurally similar devices, produced under essentially same conditions and offered for inspection at one time.

8.1.1 In the case of structurally similar devices, grouping of specimens for acceptance tests during batch acceptance shall be similar to that specified for type approval tests in the relevant detail specification.

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*Recommendation for type approval and sampling procedures for electronic components.

8.2 Acceptance Tests — Tests bracketed together within a group of subgroup are considered as a sequence and shall be performed as such using the same specimen.

8.2.1 *Group A Tests* — Group A tests shall consist only of visual examination and electrical parameters specified in the relevant detail specification. Group A tests may be performed in any order. Unless otherwise specified, the acceptable quality and inspection levels for subgroups of Group A shall be as given in Table 2.

TABLE 2 GROUP A TESTS

TITLE OF TEST	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL
(1)	(2)	(3)
Subgroup 1		
Visual examination	1	II
Other Subgroup		
Electrical parameters	1	II

8.2.2 *Group B Tests* — These tests shall be performed in the order given in Table 3. This inspection shall be applied to specimens that have satisfied the specified Group A test requirements.

8.2.3 *Failure* — Failure of a device in one or more tests of a subgroup will be counted as a single failure.

8.2.4 *Resubmitted Batch* — Batches from which defectives have been screened out or tested and which are resubmitted for batch acceptance procedure, shall contain only devices which were in the original batch. Resubmitted batches shall be kept separated from new batches and be clearly identified as resubmitted batches. No batch may be resubmitted for Group A tests after a second rejection for the same defect. No batch may be resubmitted for Group B tests after a second rejection. At the discretion of the inspection authority, testing of characteristics which are not affected by the screening process may be omitted for resubmitted batches.

8.2.4.1 Group B tests for the resubmitted batches shall be applied to specimens that have satisfied Group A test requirements.

8.2.4.2 Resubmitted batches shall be tested for all characteristics, using tightened inspection only for these characteristics in which the devices have failed.

TABLE 3 GROUP B TESTS

(*Clause* 8.2.2)

TITLE OF TEST (1)	AQL (PERCENT DEFECTIVE) (2)	INSPECTION LEVEL (3)
Subgroup 1		
Physical dimensions	4	S4
Subgroup 2		
Solderability or Resistance to soldering heat	4	S4
Temperature cycling		
Robustness of terminations and integral mounting devices		
Sealing		
Composite temperature/humidity cyclic		
Subgroup 3		
Impact or shock	4	S4
Vibration		
Constant acceleration		
Subgroup 4		
Life (steady state operation) (short term) 168 hours	4	S4
Subgroup 5		
(Applicable to plastic encapsulated devices only)	4	S4
Resistance to solvents		
Flammability		

9. GENERAL INFORMATION ON TESTS

9.1 Atmospheric Condition for Testing — Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions as given in IS : 9000 (Part I)-1977*.

9.2 The tests are subdivided into following categories:

a) Electrical,
b) Environmental, and
c) Life.

Conditions for the test and test procedures are given in the relevant standards as given below:

1) Electrical characteristics (IS : 4400† series),
2) Environmental requirements (IS : 6553-1971‡), and
3) Life tests (IS : 7412-1974§).

9.2.1 *Destructive Tests* — Unless otherwise specified, the following tests shall be classified as destructive:

a) Resistance to soldering heat,
b) Composite temperature/humidity cyclic,
c) Salt mist, and
d) Robustness of terminations and integral mounting devices.

NOTE — All other mechanical or environmental tests (other than life tests) shall be considered destructive initially, but may subsequently be considered non-destructive upon accumulation of data from five repetitions of the specified test on the same sample or product without significant evidence of cumulative degradation or failure to pass the specified test requirements.

9.2.2 *Non-destructive Tests* — Unless otherwise specified, the following tests are classified as non-destructive:

a) Physical dimensions,
b) Life (steady operation),
c) Sealing,
d) Low air pressure, and
e) Life (high temperature, non-operating).

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*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Methods of measurements on semiconductor devices.

‡Environmental requirements for semiconductor devices and integrated circuits.

§Life testing of semiconductor devices.

9.2.3 *Test Mountings (for Life Test Circuits)* — Unless otherwise specified, lead mounted semiconductor devices shall be mounted by their leads, with the mounting clips at least 10 mm from the body. The point of connection shall be maintained at a temperature not less than the specified ambient temperature.

9.2.4 *Final Measurements* — Final measurements specified in the relevant detail specification, shall be taken on each device of the sample, after the completion of all specified tests in a group. Additional readings may be taken at the discretion of the inspector. All applicable final measurements shall be performed within 96 hours after sample units have been subjected to required physical, mechanical or environmental tests.